

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims, in the application. Amendments are indicated by underscoring text to be added, and by ~~striking through~~, or [[double bracketing]] text to be deleted:

Claim 1 (previously amended): A method of making a carbon fiber reinforced composite body, comprising:

- (a) providing a reinforcement material comprising a plurality of carbon fibers;
- (b) organizing said reinforcement material to a desired bulk shape;
- (c) applying at least one coating to said fibers, said at least one coating intended to protect said fibers from chemical reaction with molten silicon, and intended to permit no more than a weak mechanical bond to the matrix;
- (d) supplying no more than about 10 percent by weight carbon to the arranged fibers to make a preform;
- (e) contacting a source of molten metal comprising silicon to said preform;
- (f) infiltrating molten metal from said source into said preform, thereby forming a composite material comprising said carbon fibers dispersed in a matrix comprising silicon carbide and said molten metal; and
- (g) solidifying said molten metal in said composite material, thereby forming a composite body comprising at least about 15 percent by volume of said metal and no more than about 25 percent by volume of said silicon carbide.

Claim 2 (previously amended): A method for making a carbon fiber reinforced composite body, comprising:

- (a) providing a porous zero-stage carbon/carbon composite preform comprising carbon fibers dispersed in a matrix consisting predominantly of carbon;
- (b) contacting said composite preform to a source of molten infiltrant metal comprising silicon ;
- (c) infiltrating silicon from said source of molten infiltrant metal into said preform, thereby forming a composite material comprising said carbon fibers dispersed in a matrix

comprising molten metal comprising silicon and at least some silicon carbide formed in-situ; and

(d) solidifying said metal in said composite material, thereby forming a composite body comprising at least about 20 percent by volume of said metal and no more than about 40 percent by volume of said silicon carbide.

Claim 3 (canceled):

Claim 4 (previously amended): A carbon fiber reinforced composite body, comprising:

(a) a plurality of carbon fibers;
(b) a matrix comprising silicon carbide and an infiltrant metal comprising silicon
(c) a zone of carbon disposed between said fibers and said matrix; and
(d) wherein said composite body comprises at least about 20 percent by volume of said infiltrant metal and not more than about 40 percent by volume of said silicon carbide.

Claim 5 (currently amended): A carbon fiber reinforced composite body, comprising:

(a) a matrix comprising silicon carbide and at least one metal comprising silicon ;
(b) a reinforcement comprising a plurality of carbon fibers; [[and]]
(c) at least one coating disposed between said fibers and said matrix, ~~said at least one coating serving functions comprising chemical protection of said carbon fibers at least from said silicon, and providing a toughening mechanism for said composite body;~~ and
(d) wherein said composite body comprises at least about 20 percent by volume of said metal and not more than about 40 percent by volume of said silicon carbide.

Claims 6 and 7 (canceled).

Claim 8 (canceled).

Claim 9 (canceled).

Claim 10 (previously amended): The composite body of claim 5, wherein said carbon fibers make up at least about 10 % by volume of said composite body.

Claim 11 (previously amended): The composite body of claim 5, comprising at least about 45% by volume of said metal.

Claim 12 (previously amended): The composite body of claim 5, wherein said silicon carbide of said matrix comprises less than about 10% of said composite body.

Claim 13 (canceled).

Claim 14 (canceled).

Claim 15 (original): The composite body of claim 5, further comprising a CTE less than about +2 ppm/K.

Claim 16 (original): The composite body of claim 5, further possessing an absolute value of CTE less than about 1 ppm/K.

Claim 17 (original): The method of claim 2, wherein said carbon of said matrix derives from at least one source selected from the group consisting of pitch, phenolic resin, furfuryl alcohol and epoxy resin.

Claim 18 (original): The method of claim 2, wherein not reacting all of said matrix carbon is accomplished by maintaining a temperature of infiltration below about 1600C.

Claim 19 (original): The method of claim 2, wherein said not reacting all of said matrix carbon is accomplished by applying said matrix carbon in a thickness greater than about 2 microns.

Claim 20 (original): The method of claim 2, wherein said not reacting all of said matrix carbon is accomplished by providing said carbon from a precursor source having a high char yield.

Claim 21 (original): The composite body of claim 5, wherein said fibers have an isotropic or quasi-isotropic arrangement.

Claim 22 (original): The composite body of claim 5, wherein said fibers are not arranged quasi-isotropically.

Claim 23 (original): The composite body of claim 5, wherein said carbon fibers possess a negative CTE in the axial direction.

Claim 24 (original): The composite body of claim 5, wherein said carbon fibers do not possess a negative CTE.

Claim 25 (original): The composite body of claim 5, wherein said carbon fibers possess an elastic modulus of at least about 200 GPa in the axial direction.

Claim 26 (canceled).

Claim 27 (original): The composite body of claim 5, wherein said reinforcement phase is present as at least one sheet or layer comprising said fibers randomly arranged within the plane of said sheet or layer.

Claim 28 (previously amended): The composite body of claim 5, wherein said reinforcement is present as at least one sheet or layer, and said thermal expansion coefficient is quasi-isotropic within the plane of said sheet or layer.

Claim 29 (previously amended): The composite body of claim 5, wherein said reinforcement is present as at least one sheet or layer comprising said fibers randomly arranged within the plane of said sheet or layer.

Claim 30 (original): The composite body of claim 5, wherein said fibers comprise graphite having a negative thermal expansion coefficient in a fiber axis direction.

Claim 31 (previously amended): The composite body of claim 28, wherein said reinforcement comprises a plurality of said layers arranged substantially parallel to one another, each of said layers comprising a plurality of substantially parallel carbon fibers, wherein an absolute value of angle as measured between the longitudinal axes of said carbon fibers in one layer and those in an adjacent layer is selected from the group consisting of 0 degrees, 45 degrees, 60 degrees and 90 degrees.

Claim 32 (original): The method of claim 1, further comprising green machining said preform.

Claim 33 (canceled).

Claim 34 (previously amended): The composite body of claim 5, wherein said matrix comprises at least one metal other than silicon.

Claim 35 (canceled).

Claim 36 (previously amended): The composite body of claim 5, wherein said silicon carbide of said matrix comprises about 1%-5% of said composite body.

Claim 37 (previously amended): A composite material comprising graphite fibers dispersed in a matrix material comprising silicon and silicon carbide, said graphite fibers possessing a negative CTE at least in the axial direction, said composite material further comprising at least

about 50 percent by volume of said silicon and not more than about 20 percent by volume of said silicon carbide.

Claim 38 (Previously presented): The composite material of claim 36, produced by a process comprising:

- (a) coating silicon carbide onto said graphite fibers;
- (b) collecting said fibers as a porous preform;
- (c) introducing a carbonaceous resin to said preform;
- (d) pyrolyzing said resin, thereby adding about 1-10 percent by weight of carbon to said preform;
- (e) contacting a source of silicon or silicon alloy in molten form to said carbon-containing preform;
- (f) infiltrating said molten silicon or silicon alloy into said carbon-containing preform, thereby forming said matrix material; and
- (g) solidifying said silicon or silicon alloy.

Claim 39 (canceled).

Claim 40 (currently amended): The composite material of claim 38 [[37]], wherein at least some of said silicon carbide is provided on said graphite fibers as a protective coating intended to prevent direct contact of said graphite fibers with said silicon during processing.

Claim 41 (Previously presented): The composite material of claim 37, wherein said fibers are provided as at least one substantially flat ply, and a coefficient of thermal expansion of said composite is quasi-isotropic within the plane of said ply.

Claim 42 (Previously presented): The composite material of claim 37, wherein said fibers are provided in the form of a plurality of stacked plies, and further wherein said fibers are substantially unidirectional within a ply, and further wherein said plies are oriented with respect

to one another as to produce a quasi-isotropic coefficient of thermal expansion within the plane of said stacked plies.

Claim 43 (canceled).

Claim 44 (canceled).

Claim 45 (Previously presented): The composite material of claim 37, comprising at least about 30 percent by volume of said fibers.

Claim 46 (previously amended): The composite material of claim 37, further comprising a coefficient of thermal expansion no greater than about 4 ppm/K.

Claim 47 (previously amended): The composite material of claim 42, wherein an overall CTE of said composite in a quasi-isotropic direction is no greater than about 3 ppm/K.

Claim 48 (Previously presented): The composite body of claim 5, wherein said at least one coating comprises elemental carbon.

Claim 49 (Previously presented): The composite body of claim 5, wherein said metal consists essentially of said silicon.

Claim 50 (Previously presented): The composite body of claim 5, wherein said silicon is present as an alloy.

Claim 51 (Previously presented): The method of claim 1, wherein said fibers make up no more than about 60 percent of a bulk volume of said bulk shape.

Claim 52 (canceled).

Claim 53 (New): The composite body of claim 5, wherein said carbon fibers are assembled in the form of a weave.

Claim 54 (New): The composite body of claim 53, wherein said weave is selected from the group consisting of a plain weave and a harness satin weave.

Claim 55 (New): The composite body of claim 5, wherein said at least one coating comprises silicon carbide.

Claim 56 (New): The composite body of claim 48, wherein said coating comprising carbon is of sufficient thickness as to function as protection of said carbon fibers from chemical reaction at least with molten silicon.

Claim 57 (New): The composite body of claim 48, wherein said coating comprising carbon is not reacted completely with molten silicon during processing, thereby leaving at least some residual coating comprising carbon that is able to function as a debond layer for said carbon fibers.

Claim 58 (New): The composite material of claim 5, produced by a process comprising:

- (a) providing a plurality of carbon fibers;
- (b) collecting said fibers as a porous preform;
- (c) introducing a carbonaceous resin to said preform;
- (d) pyrolyzing said resin;
- (e) contacting a source of silicon or silicon alloy in molten form to said pyrolyzed preform;
- (f) infiltrating said molten silicon or silicon alloy into said pyrolyzed preform, thereby forming said matrix material; and
- (g) solidifying said silicon or silicon alloy.

Claim 59 (New): The composite material of claim 5, produced by a process comprising:

- (a) providing a prepreg comprising a plurality of carbon fibers dispersed in a carbonaceous resin;
- (d) first curing, and then pyrolyzing said resin, thereby forming a zero-stage body;
- (e) contacting a source of silicon or silicon alloy in molten form to said zero-stage body;
- (f) infiltrating said molten silicon or silicon alloy into said zero-stage body, thereby forming said matrix material; and
- (g) solidifying said silicon or silicon alloy.

Claim 60 (New): The composite body of claim 59, wherein said resin is pyrolyzed under vacuum.

Claim 61 (New): The composite body of claim 59, wherein said fibers of said prepreg are highly organized.

Claim 62 (New): The composite body of claim 61, further comprising at least two of said prepreg, and wherein said at least two preregs are laminated.